New γ-γ′ Co-based superalloys are an answer for limitations of commercially used Ni-based superalloys, which no longer give possibility to improve the operating temperature of components utilized in aircraft and power industries. The new group of superalloys is an alternative for Ni-based alloys and attract the attention of more and more researchers all over the world. The conventional Co-based superalloys exhibited many beneficial properties such as melting point, thermal fatigue resistance and corrosion properties higher than those of Ni-based alloys. However, their strengthening mechanisms (carbide precipitation) was insufficient in the case of high mechanical load at elevated temperature, thus these alloys did not find the application for components of gas turbines working under extreme conditions. Nevertheless , the new group of superalloys being the subject of the project seem to be a great connection of beneficial properties of *fcc* Co-matrix and strengthening effect connected with γ′ phase of $L1_2$ type - analogous as in the Ni-based superalloys. Although these alloys exhibit high creep resistance and other advantages, their main disadvantage requiring improvement is a low oxidation resistance at high temperature, which is connected with lack of formation of continuous, protective oxide layer. Furthermore, the resistance to oxidation under cyclic conditions also requires substantial improvement in the case of discussed alloys.

The improvement of oxidation resistance may be obtained by modifying the chemical composition, most often with Cr or Si. However, these elements destabilize the γ-γ′ microstructure and decrease the creep resistance. The potential efficient solution of previously mentioned problems may be found in group 3 of the periodic table. The elements such as Y, Zr and Hf are known in the surface engineering to be elements improving the adhesion of scale and decreasing the oxidation rate of alloys based on Fe, Ni and Co, as well as enhancing oxidation performance of Ni- and Co-based coatings. Introduction of Y, Zr or Hf into alloy modifies the mechanism of oxidation and improves the adhesion of oxide layer. These elements may diffuse into scale during oxidation and enhance the bonding between the substrate and the oxide layer. Furthermore, their occurrence cause an impediment to both outward diffusion of metal cations and inward transport of oxygen anions. The similar effects are expected in the case of modification of novel γ′-strengthened alloys based on Co-Al-W and Co-Al-Mo-Nb systems.

The aim of project is determination of the kinetics and mechanism of oxidation of new Co-based superalloys modified with Y, Zr and Hf. The modification aims in improvement of both isothermal and cyclic oxidation resistance. The main assumption is that earlier mentioned mechanisms connected with the introduction of reactive elements may be effective also in the case of new alloys based on Co. Therefore, tasks connected with project include preparation of reference Co-9Al-9W and Co-10Al-5Mo-2Nb (at.%) alloys, as well as their modifications, in both cases containing minor addition of Y, Zr or Hf. The alloys will be obtained via casting method and will be subsequently subjected to the proper heat treatment (precipitation hardening) aiming in obtainment of the double-phase microstructure of γ-γ′ type. Finally, after isothermal and cyclic oxidation tests at various temperatures, the oxidation kinetic and the scale adhesion will be determined for all investigated alloys. The complex studies on oxidation resistance will show the efficiency of proposed modification. Furthermore, basing on the detailed studies of various steps of scale grown, the mechanisms of oxidation will be clearly explained. The discussed mechanism called “reactive element effect” has not been described yet in the case of γ-γ′ Co-based superalloys.

The potential improvement of the oxidation resistance as the effect of modification of chemical composition may be an important point in view of further studies aiming in implementation of new Co-based materials in aircraft and power industries. The project will result in substantial extension of knowledge concerning new γ-γ′ Co-based superalloys. Despite improving popularity of discussed alloys, the literature data is still poor in this regard, especially in case of alloys based on Co-Al-Mo-Nb system, which are a desirable issue in field of superalloys nowadays. The positive results of these modifications on various properties of new superalloys may by a milestone in optimization of chemical composition in the case of discussed alloys. Moreover, a positive result of RE-addition may also results in further studies concerning mechanical properties of newly developed γ-γ′ Co-based superalloys with improved oxidation resistance. Owing to optimized chemical composition, this group of alloys may replace the analogous Ni-based alloys in the future, or find other applications, where their beneficial properties will be crucial.